

Box 1385

SYLLABUS
OF THE
LECTURES AND LABORATORY WORK
IN THE COURSE OF
MICROSCOPY AND BIOLOGY
AT THE
SCHOOL OF MINES, COLUMBIA COLLEGE
NEW YORK

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Instruction is given during four hours each week, about one hour for lecture and three hours for practical work. The Course is arranged with special view to the students in the Courses of Chemistry and of Sanitary Engineering, extends over two years, and is thus divided:

First Year.—MICROSCOPY: The use and common applications of the microscope, and the preparation of mounts.

Second Year.—BIOLOGY: The study of the lower forms of life, especially the organisms in water and air connected with sanitary questions.

The Biological Laboratories are supplied with the general apparatus required for microscopical manipulation and biological investigation. Each student is furnished with a microscope, separate closet and drawer, and all necessary materials for independent work. A separate culture-room has been fitted up for bacterial examinations, a camera-room and a dark room for photo-micrographic work, etc.

FIRST YEAR.—MICROSCOPY.

1. *Lecture.*—Refraction of light: principle and application. Simple lens: optical principle, common materials, use of pocket loup, bull's-eye condenser. Compound lens: construction, materials, optical principle, corrections of aberrations, mode of handling, and care.

Microscope-Stand : construction, parts, choice, use, and care.

Accessory apparatus : description and use.

The Eyes : peculiarities, protection, and proper use.

Manipulation, illumination, and effect of different media.

Laboratory Work.—For several days, with low powers, on sand, air-bubbles, oil-globules, etc. Preparation of mounts in metallic air-cells.

2. *Lecture.*—DRAWING microscopic objects : with free hand, with camera-lucida to scale, enlargement, reduction.

MAGNIFICATION : methods of determination, preparation of table.

MICROMETRY : methods of determination, preparation of table and scales.

3. *Laboratory Work.*—For several days, in drawing objects previously mounted, in their measurement, and in determining magnifying powers.

3. *Lecture.*—EXAMINATION OF FOOD PRODUCTS : modes of preparation and examination, construction of cells, selection of mounting-media, solvents, section-cutting and staining. Normal structures of food and of its common adulterants.

Laboratory Work.—Spinning cells, cutting sections, staining, and preparation of mounts in soft balsam, glycerin, glycerin-jelly, Farrant's medium, etc. Examination of a series of starches, terra alba, etc., with written notes, drawings, and measurements, in the way of an original investigation by each student : *followed by lecture*, giving full information, in comparison with the observations just made by the student.

4. Examination of TEXTILE FIBRES, VEGETABLE.

Laboratory Work, for several days, on a series of common fibres, *e. g.*, cotton, flax, etc., with notes, drawings, and measurements, as before. Preparation of mounts in wax air-cells and in hardened balsam.

Lecture.—Full description of the same fibres, and comparison with notes of the student.

5. Examination of TEXTILE FIBRES, ANIMAL.

Laboratory Work.—Examination of series of animal fibres, *e. g.*, wool, silk, etc., as before, and of textile fabrics, and preparation of mounts in air-cells and in damar.

Lecture.—Full description of the animal fibres, and comparison with the notes.

6. EXAMINATION OF PAPER AND HANDWRITING.

Laboratory Work.—Identification of the fibres in specimens of paper, form of pen-nibs, furrow of the ink-line, and superposition of lines.

Lecture.—Full explanation and comparison, as before.

7. MICRO-CHEMISTRY.

Lecture.—General methods of mounting, and micro-chemical examination of chemical precipitates, etc.

Laboratory Work for several weeks.—Preparation of crystalline salts, of characteristic form, of Sodium, Potassium, etc., mounting, and examination, with written notes, drawings, and measurements.

8. MICRO-TOXICOLOGY.

Laboratory Work.—Preparation of mounts of salts of Arsenic, Corrosive Sublimate, Strychnia, etc., with examination, as before.

Lecture.—Application of the microscope to the detection of poisons.

9. REFRACTIVE INDEX.

Lecture.—Table of indices, simple methods for identification of fluids and of solids by refractive index.

Laboratory Work.—Practice in determination, on a series of objects.

10. BLOOD.

Lecture.—Physical and chemical constitution, form and size of corpuscles, natural and derivative crystals.

Laboratory Work.—Preparation and examination of mounts of blood, blood-crystals, and hæmin.

11. ABSORPTION-SPECTRA.

Lecture.—Construction and principle of micro-spectroscope, and nature and production of absorption-spectra.

Laboratory Work.—Study of spectra of blood, solutions of uranium, didymium, logwood, etc.

12. URINARY DEPOSITS.

Laboratory Work.—Mounting and examination of deposits, with drawings, etc.

Lecture.—Normal and abnormal constituents of urine.

13. IMMERSION-OBJECTIVES.

Lecture.—Construction of high-power objectives, numerical aperture, cover-correction, apochromatic objectives, choice and use of immersion-liquids.

Laboratory Work.—Practice in use of collar with water, glycerin, and homogeneous immersion-liquid. Preparation of diatom-mounts, etc., and study under high powers.

SECOND YEAR.—BIOLOGY.

As *drawing* has been the mode of illustration constantly called for, from the student, during the First Year, the course in the Second Year is introduced by a short exercise in *photographic* practice, with a view also to quicken his power of observation.

14. PHOTO-MICROGRAPHY.

Lectures.—Actinic action, preparation of gelatine-films, camera, corrections, exposure, process and theory of development, etc.

Laboratory Work.—Preparation of negatives and photographic prints of microscopic objects, with low-power objectives.

15. THE VEGETABLE CELL.

Laboratory Work.—Examination of *yeast* and *protococcus*, with notes, drawings, and measurements. Preparation of stained mounts and photo-micrographs. Study of physiological action.

Lecture.—Form and structure of the cell, its office, contents, forces, and products.

16. THE ANIMAL CELL.

Laboratory Work.—Examination of *amæba* and an *infusorian*, as above.

Lecture.—Morphology of the animal cell, and its development.

17. MOULDS AND ALGÆ.

Laboratory Work.—Examination of common green and brown moulds, diatoms, etc. Preparation of mounts in preservatives.

Lecture.—General description of the same multicellular organisms, etc.

18. BACTERIOLOGY, INTRODUCTION.

Laboratory Work.—Sterilization of apparatus, preparation of culture-media, stains, etc.

Lectures.—Nature and occurrence of bacteria, modes of isolation, culture, and study.

19. BACTERIA, GENERAL NATURE.

Laboratory Work.—Study of several common forms in the student's mouth, leptothrix, the chromogenic forms, etc. Preparation of stained mounts, drawings, etc.

Lectures.—Distribution, morphology, and modes of development of bacteria, their action and products.

20. BACTERIA IN POTABLE WATERS.

Laboratory Work.—Bacteriological examinations of waters of the Croton, Ridgewood, Hudson, Passaic, etc., with detection of species of bacteria, isolation in pure cultures, and mounts.

Lecture.—The water-bacteria, office in nature; the sewage-bacteria, the bacillus of typhoid fever; sanitary problems.

21. BACTERIA IN THE ATMOSPHERE.

Laboratory Work.—Biological examinations of the air of the streets, laboratories, cellar-vaults, etc., and isolation of species, mounts, and photographs of colonies.

Lecture.—The dust and organic contents of the atmosphere, modes of concentration and examination, and sanitary influence.

22. DISINFECTANTS AND FILTERS.

Laboratory Work.—Trial of action of various commercial disinfectants and germicides on bacteria; biological test of the purity of filtered waters.

Lecture.—Distinction of action of disinfectants and germicides, modes of trial; filtering apparatus, and efficacy of filtration.

23. THE ALGÆ AND FUNGI OF FRESH WATERS.

Laboratory Work.—Study of the yellow-green and blue-green algæ, *beggiatoa*, *crenothrix*, etc., with preparation of mounts, photographs, etc.

Lectures.—The beneficial and noxious species of *algæ*, *water-fungi*, and other organisms of waters and the atmosphere; illustrated by living specimens from a large number of aquaria and cultures.

24. ANATOMY OF THE FROG.

Laboratory Work.—Study of circulation in foot-web of living frog, dissection, nucleated blood-corpuscles, etc.

Lecture.—General discussion of the anatomical characteristics, and comparison with the student's observations.

25. SIMPLE TISSUES AND GLANDS.

Laboratory Work.—Examination of the structure of kinds of muscular tissue, the liver, etc.

Lectures.—Histology of tissues and glands, and physiological office.

